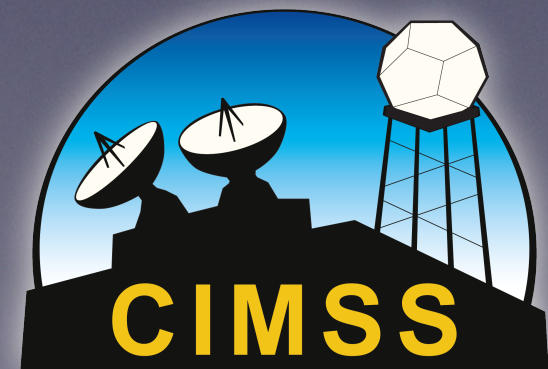


Update on Ultra Low Latency Detection of Active Fires using VIIRS and MODIS

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May 3, 2022



MODIS/VIIRS Ultra Low Latency Fire Detection

We have developed a system to receive, decode, and process MODIS and VIIRS data as quickly as possible.

The goal is to detect active fires (in CONUS) within 60 seconds of observation on the spacecraft.

Direct broadcast data are the key to making this possible.

Multiple antenna sites provide the best coverage and reliability.

Antennas currently participating in this project



Madison, WI



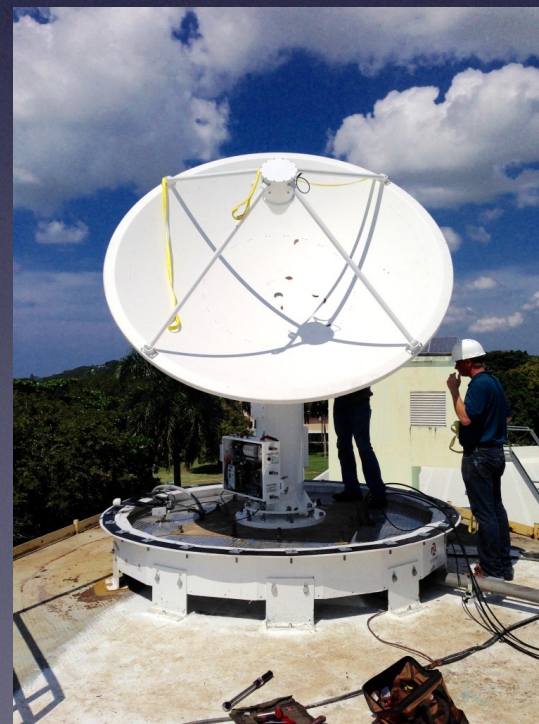
Honolulu, HI



Monterey, CA



Hampton, VA

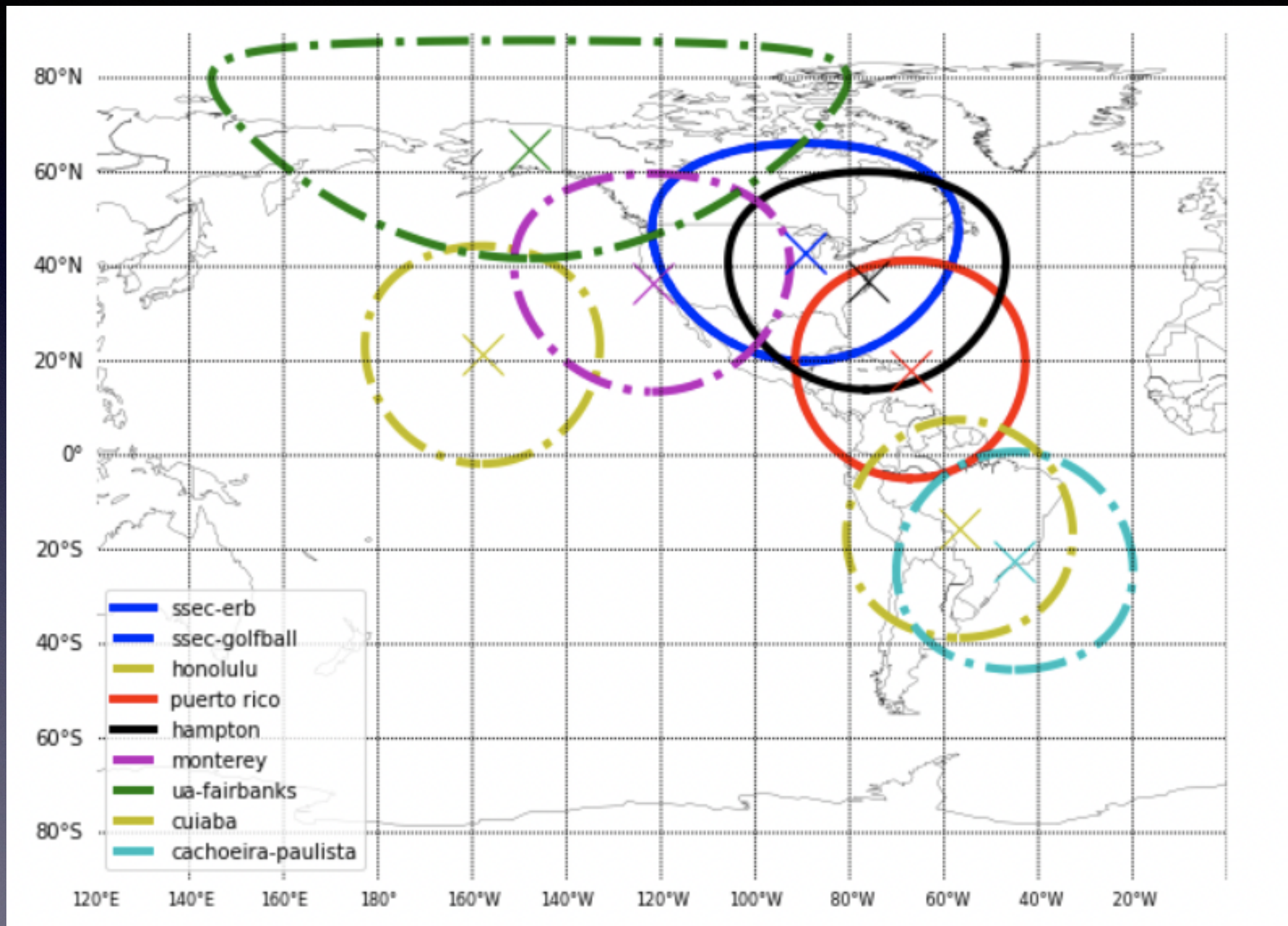


Mayaguez, PR



Madison, WI

Current and Planned Coverage



Typical 24-hour reception schedule for Madison

Tracking Schedule for Pedestal_1 on 03-May-2022 20:23:55							
92054	AQUA	N	10	DAY	03-May-2022 20:33:28	03-May-2022 20:36:21	
92053	NPP	N	09	DAY	03-May-2022 20:36:21	03-May-2022 20:43:37	
92055	FENGYUN 3D	N	10	DAY	03-May-2022 20:54:13	03-May-2022 21:02:09	
92028	NOAA 19	S	05	DAY	03-May-2022 22:43:18	03-May-2022 22:47:15	
92070	SARAL	S	29	DAY	03-May-2022 23:23:47	03-May-2022 23:35:41	
92076	ANGELS	S	42	DAY	03-May-2022 23:40:21	03-May-2022 23:49:50	
92094	NOAA 19	N	42	MIXED	04-May-2022 00:18:00	04-May-2022 00:31:04	
92101	METOP-C	S	08	NIGHT	04-May-2022 00:48:39	04-May-2022 00:54:51	
92085	SARAL	S	35	DAY	04-May-2022 01:03:05	04-May-2022 01:15:11	
92086	ANGELS	S	13	DAY	04-May-2022 01:15:11	04-May-2022 01:22:22	
92103	METOP-B	N	20	MIXED	04-May-2022 01:32:36	04-May-2022 01:43:37	
92114	NOAA 19	N	27	MIXED	04-May-2022 01:59:09	04-May-2022 02:11:28	
92115	NOAA 18	N	20	MIXED	04-May-2022 02:11:28	04-May-2022 02:18:26	
92128	METOP-C	N	54	MIXED	04-May-2022 02:24:08	04-May-2022 02:37:14	
92129	TERRA	N	22	NIGHT	04-May-2022 02:37:14	04-May-2022 02:47:14	
92089	METOP-B	N	57	MIXED	04-May-2022 03:11:10	04-May-2022 03:24:22	
92109	NOAA 18	N	62	NIGHT	04-May-2022 03:46:21	04-May-2022 03:59:52	
92125	METOP-C	N	20	NIGHT	04-May-2022 04:05:32	04-May-2022 04:16:39	
92126	TERRA	N	42	NIGHT	04-May-2022 04:16:39	04-May-2022 04:25:25	
92096	METOP-B	N	05	NIGHT	04-May-2022 04:57:11	04-May-2022 05:00:36	
92092	NOAA 18	N	06	NIGHT	04-May-2022 05:32:06	04-May-2022 05:37:27	
92116	NOAA 20	S	14	NIGHT	04-May-2022 06:21:10	04-May-2022 06:31:07	
92107	AQUA	S	19	NIGHT	04-May-2022 06:52:03	04-May-2022 07:02:02	
92108	GCOM-W1	S	22	NIGHT	04-May-2022 07:02:02	04-May-2022 07:05:15	
92093	NPP	S	40	NIGHT	04-May-2022 07:09:34	04-May-2022 07:22:28	
92105	FENGYUN 3D	S	37	NIGHT	04-May-2022 07:28:03	04-May-2022 07:40:50	
92098	NOAA 20	S	73	NIGHT	04-May-2022 08:00:13	04-May-2022 08:13:35	
92117	AQUA	S	47	NIGHT	04-May-2022 08:29:10	04-May-2022 08:40:51	
92118	GCOM-W1	S	39	NIGHT	04-May-2022 08:40:51	04-May-2022 08:43:37	
92110	NPP	S	28	NIGHT	04-May-2022 08:50:04	04-May-2022 09:02:02	
92090	FENGYUN 3D	S	30	MIXED	04-May-2022 09:08:27	04-May-2022 09:20:39	
92127	NOAA 20	S	11	NIGHT	04-May-2022 09:42:05	04-May-2022 09:50:17	
92088	ANGELS	N	23	DAY	04-May-2022 10:21:17	04-May-2022 10:30:00	
92087	SARAL	N	47	DAY	04-May-2022 10:41:51	04-May-2022 10:54:24	
92124	ANGELS	N	24	DAY	04-May-2022 11:55:07	04-May-2022 12:04:00	
92104	SARAL	N	21	DAY	04-May-2022 12:22:12	04-May-2022 12:33:16	
92091	NOAA 19	S	16	DAY	04-May-2022 12:39:29	04-May-2022 12:50:00	
92097	NOAA 19	S	71	DAY	04-May-2022 14:19:03	04-May-2022 14:32:46	
92095	METOP-C	S	20	DAY	04-May-2022 14:40:55	04-May-2022 14:52:00	
92106	METOP-B	S	53	DAY	04-May-2022 15:27:20	04-May-2022 15:40:28	
92133	NOAA 19	S	11	DAY	04-May-2022 16:01:18	04-May-2022 16:07:03	
92132	NOAA 18	S	52	DAY	04-May-2022 16:07:03	04-May-2022 16:11:59	
92131	TERRA	S	44	DAY	04-May-2022 16:11:59	04-May-2022 16:20:20	
92130	METOP-C	S	54	DAY	04-May-2022 16:20:20	04-May-2022 16:33:24	
92099	NPP	N	11	DAY	04-May-2022 16:56:38	04-May-2022 17:05:01	
92119	METOP-B	S	22	DAY	04-May-2022 17:08:00	04-May-2022 17:19:13	
92120	FENGYUN 3D	N	10	DAY	04-May-2022 17:19:13	04-May-2022 17:23:28	
92080	NOAA 20	N	28	DAY	04-May-2022 17:44:57	04-May-2022 17:57:00	
92083	TERRA	S	21	DAY	04-May-2022 17:57:00	04-May-2022 17:58:56	
92082	AQUA	N	24	DAY	04-May-2022 17:58:56	04-May-2022 18:02:44	
92081	METOP-C	S	07	DAY	04-May-2022 18:02:44	04-May-2022 18:08:51	
92084	GCOM-W1	N	28	DAY	04-May-2022 18:08:51	04-May-2022 18:12:31	
92112	NPP	N	75	DAY	04-May-2022 18:33:26	04-May-2022 18:46:49	
92102	FENGYUN 3D	N	70	DAY	04-May-2022 18:52:05	04-May-2022 19:05:25	
92121	NOAA 20	N	39	DAY	04-May-2022 19:24:35	04-May-2022 19:37:27	
92122	AQUA	N	38	DAY	04-May-2022 19:37:27	04-May-2022 19:47:29	
92123	GCOM-W1	N	32	DAY	04-May-2022 19:47:29	04-May-2022 19:50:22	
92111	NPP	N	14	DAY	04-May-2022 20:16:00	04-May-2022 20:25:48	

Reception Priorities (1=highest)

1.Suomi NPP, NOAA-20

2.Metop-B, Metop-C

3.Terra, Aqua

4.NOAA-18, NOAA-19

5.GCOM-W1

6.FY-3D

7.SARAL, ANGELS

11 SNPP/NOAA-20 passes

8 Terra/Aqua passes

11 Metop-B/C passes

10 NOAA-18/19 passes

58 total passes

MODIS/VIIRS Direct Broadcast

NOAA-20, Suomi NPP, Terra, and Aqua provide real-time direct broadcast (DB) of sensor observations on X-band.

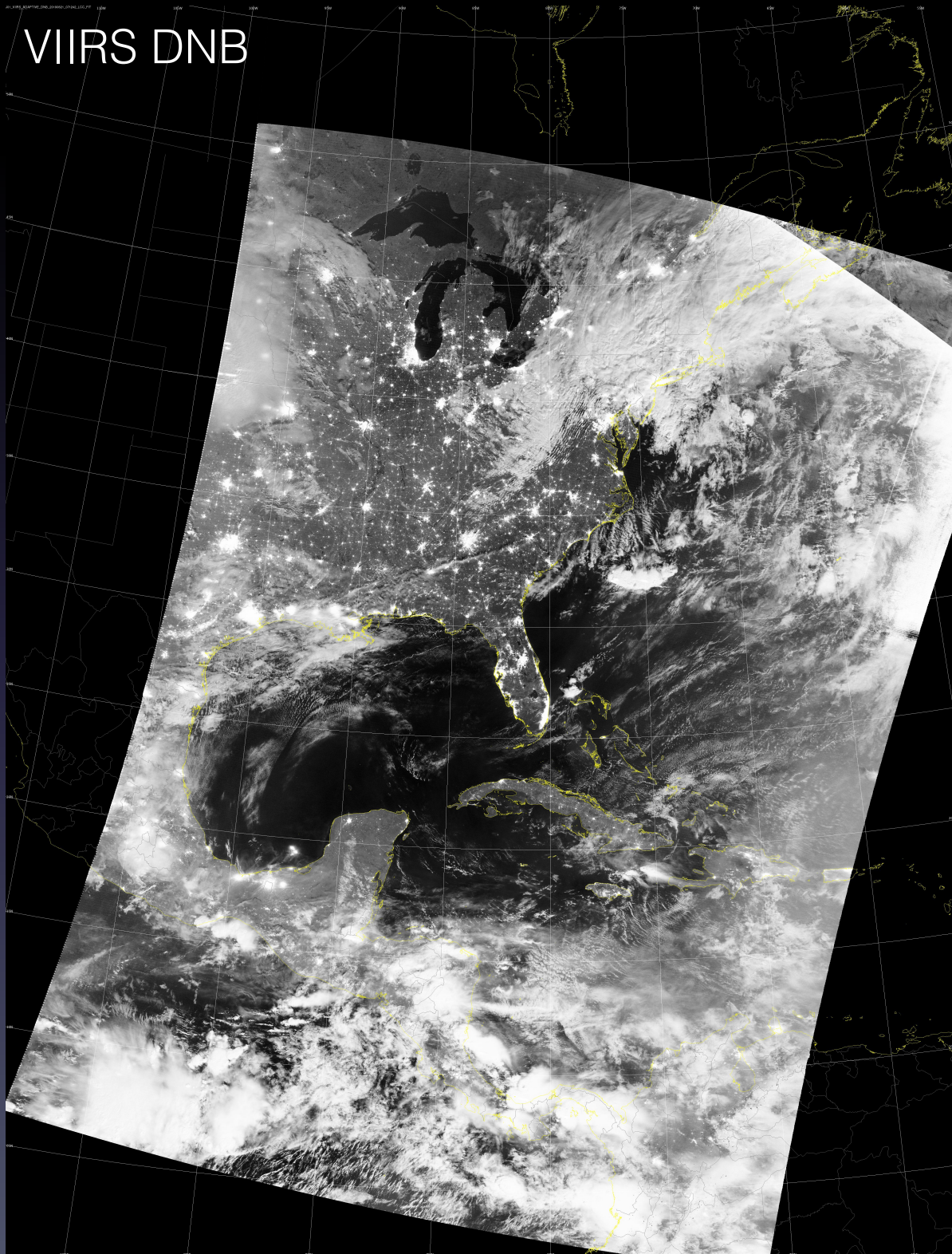
Affordable X-band antennas for receiving and decoding these DB transmissions have been available for > 20 years (starting with Terra in 2000).

Freely available software for decoding and processing the data makes it possible to create Level 1B and Level 2 products from the DB data.

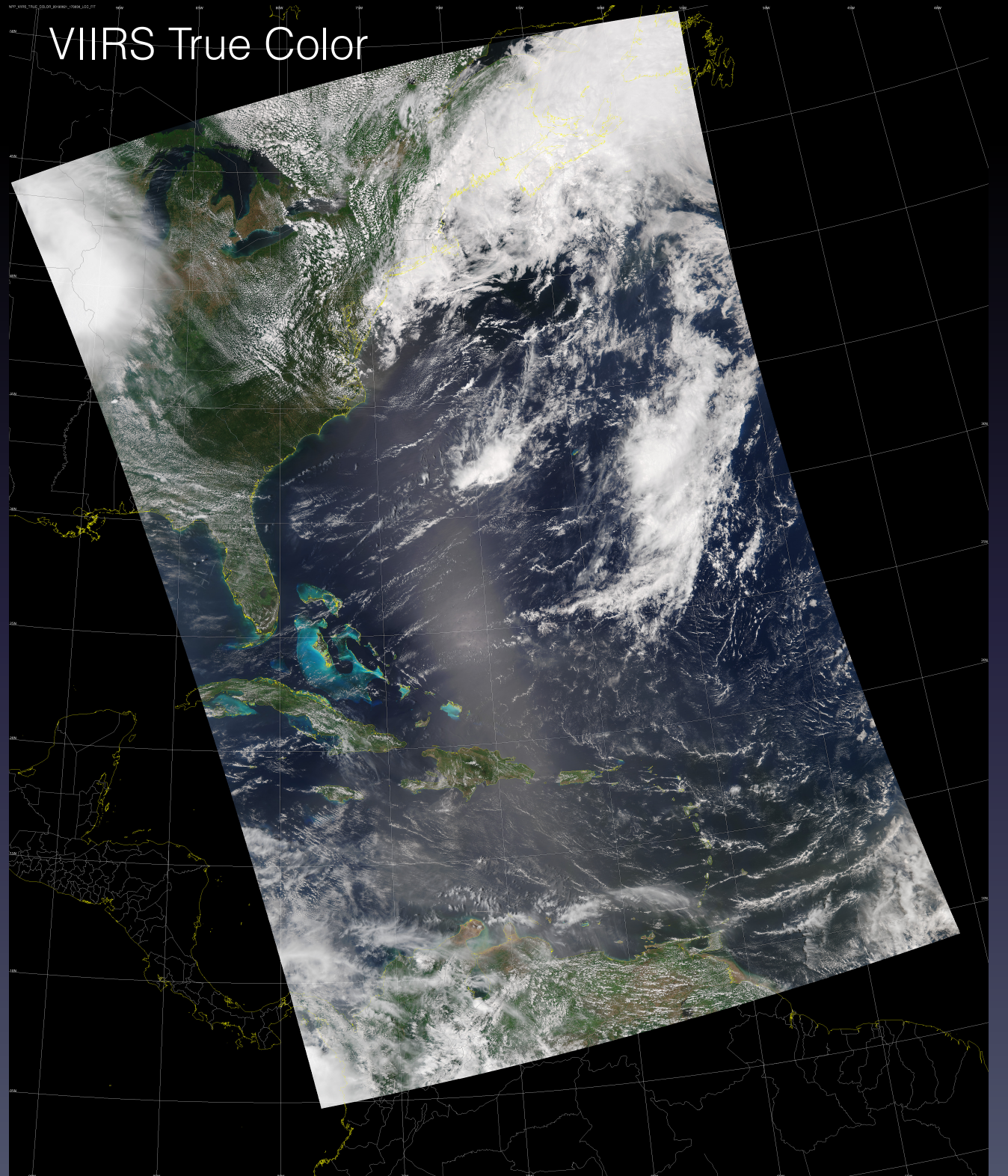
VIIRS Direct Broadcast Data Coverage

NOAA-20 Direct Broadcast data from Miami antenna 2019/06/21

VIIRS DNB



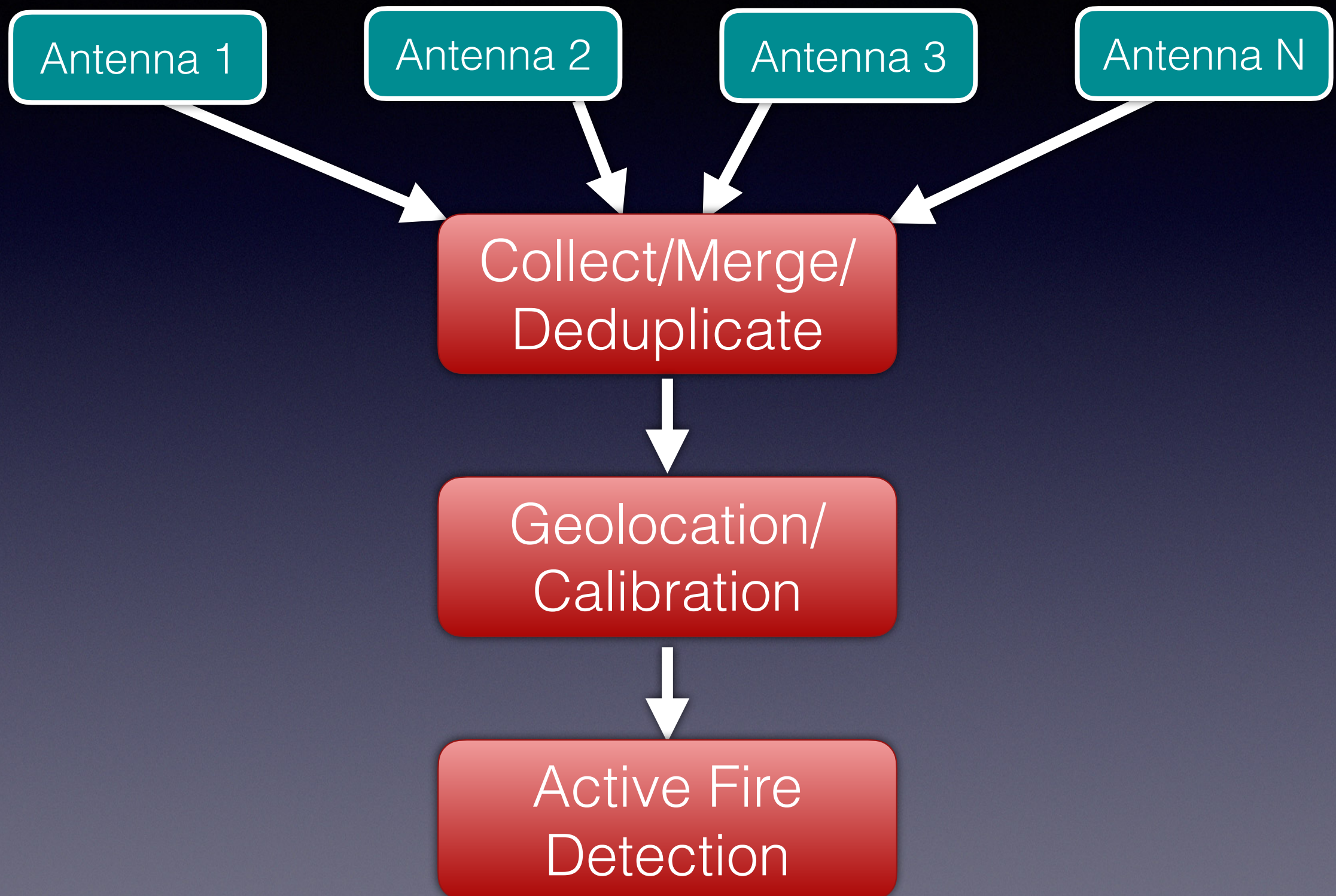
VIIRS True Color



Enabling factors for ultra low latency

1. Direct access to multiple DB antennas in CONUS (Madison WI x 2, Hampton VA, Mayaguez PR).
2. Software systems to stream the DB data (as CCSDS packets) in real-time from each antenna to a central collection point.
3. Software systems to ingest, merge, and de-duplicate the CCSDS packets in real-time.
4. Software systems to process “micro-granules” through Level 1 (geolocation, calibration) and Level 2 (active fire detection).

Ultra Low Latency Data Flow



Data Ingest & Processing Workflow

1. CCSDS Level 0 packets are streamed in real time from multiple remote antenna sites to a merging/de-duplication application at SSEC.
2. De-duplicated packets are streamed to a collector application that assembles 5-second buckets. A message is sent when a new 5-second bucket has been populated.
3. A processor application listens for messages from the collector, and when it has sufficient data to process it starts the processing for that “micro granule” (currently 3 x 5 second buckets; yielding 3-4 scans for MODIS and 2-3 scans for VIIRS).
4. The processor immediately runs the Level 1A/GEO/CAL software followed by the active fire detection.

Current Status

- Ultra low latency data are received from Madison (x 2 antennas), Hampton, and Mayaguez.
- Standard low latency data are received from Honolulu and Monterey (after the pass is complete).
- MODIS data are processed via OCSSW and MOD14; VIIRS data are processed via VIIRS L1 and VFIRE375.
- Fire locations are converted to CSV and are provided to LANCE/FIRMS via Web API.
- MODIS latency is ~ 25 seconds; VIIRS is ~ 50 seconds for data ingested and processed in real time.
- Have tested VIIRS data ingest from two antennas in Brazil; have requested VIIRS data from Univ. of Alaska Fairbanks.

Low Latency Fires in FIRMS (5/4/2022)

